Missouri Target Industry Competency Model

Energy

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Access to skilled workers is one of the foremost criteria that companies and site selectors consider when locating and expanding business in Missouri. The ability to show companies an available and sustainable pipeline of skilled workers continues to be the difference in Missouri's ability to turn economic development assets into high quality job opportunities. To support these efforts the research arm of the Department of Economic Development, the Missouri Economic Research and Information Center (MERIC), has embarked on a project to bring together the appropriate state and local individuals to align education and workforce programs with the future talent development needs of companies.

Industry clusters are defined as groups of interdependent businesses linked by core products or services as well as the potential for common supply chains, labor needs, technology and markets. Those currently identified for the study are:

- Agribusiness
- Automotive
- Defense & Homeland Security
- Energy
- Finance
- Information Technology
- Life Sciences
- Transportation/Logistics

For these industry clusters, Target Industry Competency Models are being developed with the help of target employers and education/training providers in the state.

The globalized marketplace along with the rapid development of technology has created a work environment where information and technology are the key ingredients for success in business. To reduce the gap between knowledge and ability there is a need for workers to have a better understanding of the skill sets needed for a job. By hiring properly trained individuals, organizations save money and spend less time preparing their staff in their work roles, while colleges and universities have a better understanding towards curriculum development and maintenance [1].

The Target Industry Competency Model project is intended to identify personal effectiveness, academic and occupation specific competencies for targeted businesses within the state's Energy industry cluster. The objective of designing a Competency Model is to develop a dynamic, industry-driven framework necessary for workers that will help them meet the demands of a globally competitive economy. This study is intended to provide an accurate knowledge of the current and future skill requirement that can enable timely direction of resources, development and revision of industry-relevant curriculum and efficient development of career information and job profiles.

In the first part of this report, foundational skills are identified at three levels: Personal Effectiveness, Academic and Workplace. Next, industry level competencies are listed. Sector specific technical competencies within the areas of **Electric Transmission & Distribution**, **Gas Transmission & Distribution**, **Non-Nuclear Generation** and **Nuclear Generation** are developed. Finally, specialized training/education programs for an identified target list of Energy occupations are also discussed. These results will hopefully serve as a useful human resource tool within organizations and to help shape policies that will address any skill and curriculum gaps in order to meet the future needs of Missouri businesses.

In addition to the results of the model, some key findings of this report include:

- One of the key challenges facing this industry is an aging workforce. The imminent retirement of a large segment of workers could result in a shortage of this specialized labor pool.

- Workers will need to enhance their existing skills sets to meet the demands of new and evolving technologies used in this industry.

- This industry has a significant impact on the economy that is increasing with increased demand for energy and call for more renewable energy alternatives.

- Employers in this industry provide good pay and generous benefits. In order to attract more students towards these careers there is a need for more public awareness about these jobs.

Interesting Missouri Energy facts:

➢ By 2018, it is expected that there will be a total of 1,061 job openings among the Targeted Occupations* in the Energy field within the state.[2]

➢ By 2025, Missouri's older population groups are projected to increase in size relative to the state's population as a whole.[3]

➢ 60% of Missouri's workforce in 2025 is already working today.[3]

➢ The average salary for the Targeted Occupations in Energy within the state is $45,633 with $29,343 for entry level and $53,778 for experienced workers.[2]

*Targeted Occupations are those with high employment, good growth and above average salaries.

What is a Competency Model?

A competency is a specific, identifiable, definable and measurable skill or characteristic that is essential for the performance of an activity within a specific business or industry context. Some examples of competencies are safety awareness, critical analytical thinking, problem solving, communication and team work.

The first competency model was developed in the early 1970's for the US Department of State by David McClelland and his colleagues of McBer and Company as an alternative selection tool for junior Foreign Service Information Officers. Later McBer and Company developed a methodology that is still highly useful today in competency model building and comprises of "*focus on outstanding performers, use of behavioral event interviews and thematic analysis of interview data and distillation of the results into a smaller set of competencies described in behaviorally specific terms*". In the last 30 years this technique has gained importance as an integral practice in human resource management[4].

Based on the US Department of Labor's (DOL) framework, the competency model can be described as a pyramid consisting of a hierarchical set of tiers. The pyramid is divided into 3 main blocks of **Foundational**, **Industry Related** and **Occupation Related competencies**. Each of these blocks is made up of tiers which consist of a set of competencies that represent the skills, knowledge and abilities essential to be successful in an occupation in the industry the model represents.

Source: www.CareerOneStop.org/CompetencyModel

Starting from the base, the tiers cover competencies that are common to several occupations and industries. As we traverse up the pyramid, the competencies become industry and occupation specific. It is important to note that the above picture does not suggest that this is a sequential model i.e. one needs to have all the below competencies in order to posses / develop the higher level competencies. The model is constructed in a bottom-up approach using a combination of research, data collection and analysis, focus groups and case study interviews.

Uses of Competency Models

Competency Models benefit a wide array of users; as a standard set of skills that can be used for recruiting, profiling jobs, evaluating employees and designing academic and professional certification programs. They serve as a bridge between educators, businesses and other stakeholders who are invested in preparing students and workers for today's workplace challenges.

Competency Models can be used by employers as a **useful selection and professional development tool**. It can assist HR staff match specific skills and work requirements to different jobs during selection, promotion, career path development and while developing training programs for the organization. It can help to assess performance of individuals in their jobs as well as in their roles of managers, direct reports, customers and team members. It can also be a means for businesses to communicate their performance expectations to their workers.

Competency Models can serve as a **measure of the gap between employer needs and the offerings of the current education and training delivery system**. Contents of existing coursework can be reviewed and mapped against the tier competencies and a crosswalk can be created and "gaps" can be identified. As education or training providers evaluate existing programs or design new ones, the Competency model can **serve as a benchmark**, resulting in addition of courses that will match workplace requirements and trends[5].

Training providers can also use competency models to **develop industry-validated certifications**. Acquiring such a certification establishes that the graduate of the particular training program has demonstrated mastery in the competencies as stated in model for that industry or sector[6].

Competency models work as a guide for Workforce Investment Boards and One Stop Career Centers to **match job requirements and skill sets determined by employers to potential candidates**. In this way an even larger group of individuals such as in-school youth, out-of school youth, dislocated workers, current workers and special needs populations are serviced, thus increasing the talent pool of available workers.

As these key partners work together by sharing assets and resources, the competency model provides a **good guidance for government investments in workforce preparation strategies** within a region or the state.

Best Practices

A great deal of research has been done to design competency models by both the private sector and government agencies, to address their respective skill needs.

The Washington State Board for Community and Technical College has developed the Energy Industry Skill Standards. The goal of this project is to specify the critical work functions, key activities, performance indicators and knowledge, skills and abilities an individual needs to succeed in certain energy-related occupations. The result of this project will support the development of new curriculum and the strengthening of existing curriculum in programs leading to certain careers in the energy industry.[7].

The Center for Energy Workforce Development (CEWD) utilizes the Competency model framework defined by US Department of Labor, as a tool educators, workforce investment professionals and businesses to articulate the skills required to perform the work so that effective screening of candidates can occur and training courses can be developed to prepare candidates for work in the industry[8].

The Utah State Office of Education makes use of the Technology & Engineering Pathways. The mission of technology education in Utah is to enable students to understand, design, produce, use and manage the human-made world, in order to contribute and function in a technological society.[9]

Mid Continent Research For Education and Learning (MCREL) has created a subject standard that provides teachers and administrators with valuable information about proven, effective approaches to the challenges in education today. By building on research to solve specific problems, MCREL develops widely acclaimed PreK-16 educational products that are used in classrooms nationally and internationally to help educators maximize student learning[10].
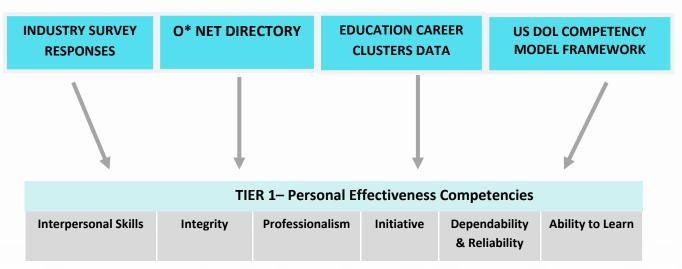
Competency Model

Workplace Competencies

Academic Competencies

Personal Effectiveness Competencies

The **Foundational Competencies** block includes Tiers 1 through 3 in which the essentials for early success in school and work life are identified. These competencies are integral for all workers to be successful in any organization, across all occupations and in all industries. An industry survey with a specific set of questions was designed and administered to Energy industry professionals in the state to identify the competencies in this tier. Often business leaders elaborated on certain competencies outside the survey questions, which was also incorporated into the tiers.

Tier 1: Personal Effectiveness Competencies

Starting at the bottom of the pyramid, this tier is comprised of competencies that are often referred to as "soft skills" and essential in all life roles. Using the US-DOL competency model as a framework, the survey results were mapped against O*Net (a system that serves as the nation's primary source of occupational information, providing comprehensive information on key attributes and characteristics of workers and occupations)[11] and Education Clusters data to develop this tier.

INDUSTRY SURVEY RESPONSES	O* NET DIRECTORY	EDUCATION CAREER CLUSTERS DATA	US DOL COMPETENCY MODEL FRAMEWORK

TIER 1– Personal Effectiveness Competencies					
Interpersonal Skills	Integrity	Professionalism	Initiative	Dependability & Reliability	Ability to Learn

Each competency is then described in terms of behavioral attributes.

Interpersonal Skills

Attributes
Maintains open communication with others, recognizes and accurately interprets the verbal and non verbal behavior of others
Demonstrates flexibility and open mindedness when dealing with a wide range of people
Displays adequate concern for others by being sensitive to their needs and feelings

Integrity

Attributes
Treats others with honesty, fairness and respect
Accepts responsibility of one's actions and decisions
Behaves ethically and reports unethical behavior demonstrated by others to supervisors

Professionalism

Attributes
Demonstrate self discipline, self-worth and positive attitude in a work situation
Is free from substance abuse
Maintains a professional appearance
Complies with organizational policies and procedures

Initiative

Attributes
Pursues work with energy, drive and goes beyond routine demands of the job
Strives to exceed standards and expectations
Establishes and maintains personally challenging but realistic work goals
Is able to perform effectively even with minimal direction and support

Dependability & Reliability

Attributes
Follows policies and procedures, thus exhibiting commitment to the organization
Diligently follows through on commitments and consistently meets deadlines
Demonstrates regular and punctual attendance

Ability to Learn

Attributes
Uses material taught in classroom and on the job training in work situations
Treats unexpected circumstances as opportunities to learn and adopt new techniques
Desires, shows willingness to learn new assignments, procedures and technologies

Foundational Competencies

Tier 2—Academic Competencies

The second tier in the Foundational competencies block covers basic educational competencies that are learned in an educational setting along with cognitive functions and thinking styles. Typically these competencies form the foundation for the Occupation and Industry specific Competencies. This tier was also developed by mapping the survey results against O*Net and Education Clusters data.

INDUSTRY SURVEY RESPONSES	O* NET DIRECTORY	EDUCATION CAREER CLUSTERS DATA	US DOL COMPETENCY MODEL FRAMEWORK

TIER 2 – Academic Competencies				
Reading	Mathematics	Engineering & Technology	Communication: Listening & Speaking	Critical & Analytical Thinking

Each competency is then described in terms of behavioral attributes.

Reading

Attributes
Sorts through distracting information and scans written material for subject of interest
Is able to identify main ideas and correctly interpret written material
Integrates and applies what is learned from written material to complete specific tasks

Mathematics

Attributes
Adds, subtracts, multiplies and divides with whole numbers, fractions, decimals and percents; calculates average, ratios, proportions and rates
Takes measurement of time, temperature, distance, length, width, height , perimeter etc.
Correctly converts from one measurement to another
Translates practical problems into useful mathematical expressions and uses appropriate mathematical formulas and techniques
Solves simple algebraic equations
Is able to determine slope, midpoint and distance
Calculates perimeters, areas and volumes of basic shapes and solids
Reads, tracks and calculates gauge measurements

Engineering and Technology

Attributes
Applies basic engineering principles and the appropriate technical solution to a problem
Applies principles of engineering science and technology, techniques, procedures and equipment to the design and production of various goods and services
Applies the basics of electricity
Identifies and selects the appropriate hand or small electric tools or diagnostic equipment for the work
Solves problems where a variety of mechanical, electrical, thermal or fluid faults could be the reason for the problem

Communication: Listening and Speaking

Attributes
Listens carefully to others and correctly interprets information provided by others
Speaks clearly, in a logical organized and coherent manner
Is able to incorporate information into actions

Critical and Analytical Thinking

Attributes
Identifies inconsistent or missing information
Critically reviews, analyzes, synthesizes, compares and interprets information
Tests possible hypotheses to ensure the problem is correctly diagnosed and the best solution is found

Foundational Competencies

Tier 3 —Workplace Competencies

The competencies in this tier include those skills and abilities that permit an individual to conduct his/her work related activities in an effective and efficient manner. These competencies were derived from the Education Career Cluster Data and the US DOL Competency Model Framework.

EDUCATION CAREER CLUSTERS DATA	US DOL COMPETENCY MODEL FRAMEWORK

TIER 3 – Workplace Competencies				
Teamwork	Planning & Organizing	Working with Tools & Technology	Problem Solving & Decision Making	Following Directions

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Each competency is then described in terms of behavioral attributes.

Teamwork

Attributes
Accepts membership in team and uses best practices for successful team functioning
Works effectively in multi-disciplinary teams
Gives and receives feedback constructively
Leverages the strengths of others to accomplish a common goal
Is open to considering new ways of doing things and the merits of new approaches to work

Planning & Organizing

Attributes
Prioritizes various competing tasks and performs them quickly and efficiently according to their urgency
Finds new ways of organizing work area or planning work to accomplish work more efficiently
Estimates resources needed for project completion; allocated time and resources effectively
Anticipates obstacles to project completion and develops contingency plans to address them; take necessary corrective action when projects go off-track
Plans and schedules tasks so that work is completed on time
Makes arrangements that fulfill all requirements as efficiently and economically as possible
Responds to the schedules of other affected by arrangements; giving them complete, accurate and timely information
Keeps track of details to ensure work is preformed accurately and completely
Takes steps to verify all arrangements, recognizes problems, generates effective alternatives and takes corrective actions
Effectively coordinates the transition of employees at the beginning and end of each work shift; disseminates crucial information in an organized manner to rapidly bring employees up to speed at the start of their shifts

Working with Tools & Technology

Attributes
Selects and applies appropriate tools or technological solutions to frequently encountered problems
Carefully considers which tools or technological solutions are appropriate for a given job and consistently chooses the best tool or technological solution for the problem at hand
Demonstrates an interest in learning about new and emerging tools and technologies; seeks out opportunities to improve knowledge of tools and technologies that may assist in streamlining work and improving productivity
Knows how to maintain and troubleshoot tools and technologies
Uses basic computer technology to receive work orders, report progress and maintain records

Foundational Competencies

Problem Solving & Decision Making

Attributes
Anticipates or recognizes the existence of a problem
Identifies the true nature of the problem by analyzing its component parts
Effectively uses both internal and external resources to locate and gather information; examines information obtained for relevance and completeness; recognizes important gaps in existing information and takes steps to eliminate those gaps; recalls previously learned information that is relevant to the problem; organizes information as appropriate to gain a better understanding of the problem
Integrates previously learned and externally obtained information to generate a variety of high quality alternative approaches to the problem
Skillfully uses logic and analysis to identify the strengths and weaknesses, the costs and benefits and the short and the long-term consequences of different approaches
Decisively chooses the best solution after contemplating available approaches to the problem; makes difficult decisions even in highly ambiguous or ill-defined situations; quickly chooses an effective solution without assistance when appropriate
Commits to a solution in a timely manner and develops a realistic approach for implementing the chosen solution; observes and evaluates the outcomes of implementing the solution to assess the need for alternative approaches and to identify lessons learned
Uses scientific rules and methods to solve problems

Following Directions

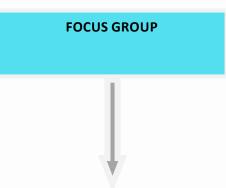| Attributes |
| --- |
| Receives, interprets, understands and responds to verbal messages and other cues |
| Picks out important information in verbal messages |
| Interprets complex instructions and their relevance to the work assignment |
| Asks questions to clarify unclear directions |
| Acts upon the instruction to complete an assignment |

Foundational Competencies

Industry-Sector Technical Competencies

Industry-Wide Technical Competencies

The second block of the pyramid is **Industry Related Competencies** that are common to all jobs within a particular industry, i.e. Energy in this case. Tiers 4 & 5 reflected the consensus of industry professionals collected from these experts in a tightly-focused work session. The panel consisted of business leaders, managers and education and training providers.

Tier 4 —Industry-Wide Technical Competencies

The first tier in Industry related competencies represents the knowledge, skills and abilities required by all occupations within a specific industry. Each industry has a unique set of technical competencies that have been defined by the respective subject matter experts (SME's). To derive these competencies representatives from Missouri's Energy industry met and brainstormed in a focus group setting.

FOCUS GROUP

TIER 4 – Industry-Wide Technical Competencies				
Industry Concepts & Fundamentals	Business & Financial Management	Regulatory Compliance	Operations & Maintenance	Safety & Security

Each competency is further described in terms of the technical content areas.

Industry Concepts & Fundamentals

Basic industry knowledge and concepts

Contractor Management

Data Analysis

Electrical System Mountainous - Plant, Distribution, Transmission

Engineering concepts- Electrical, Mechanical, Biological, Chemical, Civil or Nuclear

Fleet Servicing Management

GIS Skills

Heat transfer systems

Insulation Application

Mechanical Maintenance

Operational Procedures - Developing / Applying

Operations

Pipe Fitting

Power Generation technology

Process Controls

Procurement

Pure Science concepts - Chemistry, Agriculture and Physics

Quality Control

Rotating Machinery Maintenance

SCADA skills

SCADA systems- Supervisory Control and Data Acquisition

Steam Fitting

Vehicle Management

Water Chemistry

Welding

Business & Financial Management

Basic business knowledge

Continuous Improvement

Contract / MOU agreements

Contractor Relations

Efficiency and Economics

Financial Analysis- business modeling and finance

Management - Project Management, Construction Management, Marketing Management

Materials Procurement

Networking

Planning & Scheduling

Procurement skills

Purchasing / Buyers

Real Estate Acquisition

Resource Accounting

ROW - Vegetation Management, Acquisition Management, Leasement information
Shareholder awareness - cost and trim savings

Regulatory Compliance

FEMA, SEMA

Basic of Regulations and Regulatory Agencies that oversee electric industry

Industry Codes and Standards

Laws and Regulations

State and Federal Statutes

Technical Specifications Development

Operations & Maintenance

Day to day Operations

Electrical Systems Maintenance

General Maintenance Skills

Testing and Start up

Troubleshooting

Safety & Security

Conservation

Environmental Safety

Facility and Cyber Security
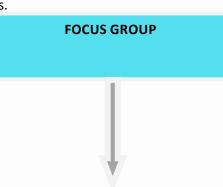
General Energy Administration

Industrial Safety

Safety Awareness

Safety Compliance

Industry Related Competencies

Tier 5 —Industry-Specific Technical Competencies

This tier includes competencies that represent knowledge, skills and abilities required for occupations within a specific industry sector. Missouri staffing patterns reflected high employment in specific sectors such as **Electric Transmission & Distribution, Gas Transmission & Distribution, Non-Nuclear Generation and Nuclear Generation**. Within each of these sectors, Knowledge Areas (KAs) were identified. These KA's provide a list of competencies that workers in the specific industry must have to be effective in their occupations.

FOCUS GROUP

TIER 5 – Industry-Specific Technical Competencies			
Electric Transmission & Distribution	**Gas Transmission & Distribution**	**Non-Nuclear Generation**	**Nuclear Generation**
Fundamentals of Electricity	Fundamentals of Natural Gas	Coal gasification, Mercury Management	Control Room Operations
Communications	Gas Distribution - Odorgation, Measurement, State Regulations, Rate Making, Storage, Conservation, Marketing	Combustion Gas Cleaning	Electrical Science
Computer Modeling	Gas Exploration - Geological & Environmental	Conservation Practices	Fuel Processing
Control Device Design	Gas Production - Scrubbing	Control Room Operations	Nuclear Regulatory Commission (NCR) Rules and Regulations
Dispatching	Gas Transmission – Fed Pipeline Regulations, Measurement, Odorgation, Trading and Marketing	Electrical Science	Nuclear Generation
Electrical Systems Management	Heat Recovery Steam Generator	Environmental Compliance and Reporting	Welding

TIER 5 – Industry-Specific Technical Competencies(cont'd)			
Electric Transmission & Distribution	**Gas Transmission & Distribution**	**Non-Nuclear Generation**	**Nuclear Generation**
Electrical Engineering	HRSG Technology	Fuel Management – procurement, scheduling, receiving, inventory, sustainability	----
Fleet Management	-----	Gasification	
Forecasting Infrastructure		Heavy Equipment Operations	
Land purchasing condemnation		Maintenance Planning and Engineering	
Line building and Lineman skills		Mechanical Systems Maintenance	
Load Management		Methanization	
Power Trading		Sustainable operations	
Safety		Organization of fuel Stock	
Smart Grid knowledge		Plant Efficiency and Optimization	
Substation construction		Plant repair and renovation, planning and budgeting	
Vegetation Management		Power (electricity systems maintenance)	
		Process Controls and Communication	
		Procurement	

Industry Related Competencies

Management Competencies

Occupation-Specific Requirements

Occupation-Specific Technical Competencies

Occupation-Specific Knowledge Areas

The last group consists of **Occupation related competencies** and is defined in terms of occupation related knowledge, education, credentials and performance. They are derived from the O*Net directory. A specific list of Energy occupations has been focused on in these tiers. The eleven Targeted Energy occupations were identified by creating a custom industry staffing pattern for the Energy industry cluster in Missouri. This was sorted by each occupation's impact on the economy and then mapped against the US DOL's In Demand occupation list for Energy. This list was then vetted by the State's industry specialists and is described below:

O*NET-SOC Code	Title
17-2041	Chemical Engineers
17-2071	Electrical Engineers
19-2031	Chemists
47-2111	Electricians
49-1011	First-Line Supervisors/Managers of Mechanics, Installers and Repairers
49-2094	Electrical and Electronics Repairers, Commercial and Industrial Equipment
49-2095	Electrical and Electronics Repairers, Powerhouse, Substation and Relay
49-9041	Industrial Machinery Mechanics
49-9042	Maintenance and Repair Workers, General
49-9051	Electrical Power-Line Installers and Repairers
51-8013	Power Plant Operators

It is important to note that the occupations in this list were obtained from the state's list of occupations in the Energy cluster and do not include the entire gamut of occupations available within this industry.
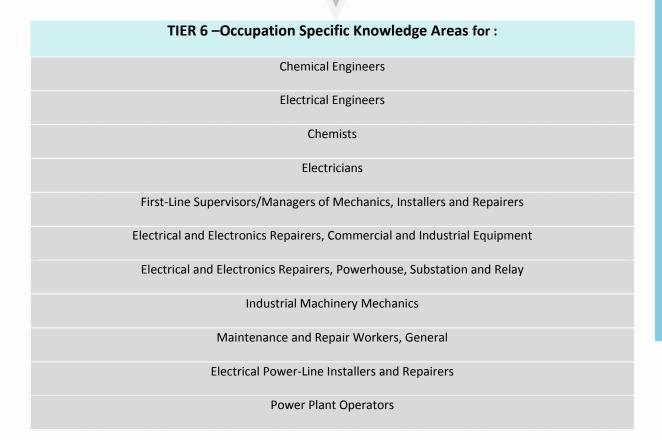
Tier 6 —Occupation-Specific Knowledge Areas

This tier contains the specific **knowledge areas** that are required for the eleven targeted Energy occupations. Each knowledge area covers an area of expertise that the respective occupation requires.

O* NET DIRECTORY

TIER 6 –Occupation Specific Knowledge Areas for :
Chemical Engineers
Electrical Engineers
Chemists
Electricians
First-Line Supervisors/Managers of Mechanics, Installers and Repairers
Electrical and Electronics Repairers, Commercial and Industrial Equipment
Electrical and Electronics Repairers, Powerhouse, Substation and Relay
Industrial Machinery Mechanics
Maintenance and Repair Workers, General
Electrical Power-Line Installers and Repairers
Power Plant Operators

Occupation Related Competencies

Chemical Engineers

- Engineering and Technology
- Chemistry
- Mathematics
- Physics
- Production and Processing
- English Language
- Design
- Administration and Management
- Computers and Electronics
- Mechanical

Electrical Engineers

- Engineering and Technology
- Design
- Computers and Electronics
- Mathematics
- Physics
- English Language
- Mechanical
- Administrations and Management
- Customer and Personal Service
- Public, Safety and Security

Chemists

- Chemistry
- Mathematics
- Computers and Electronics
- English Language
- Productions and Processing
- Customer and Personal Service
- Clerical
- Engineering and Technology

Electricians

- Mechanical
- Building and Construction
- Mathematics
- Design
- Administration and Management
- Customer and Personal Service
- Engineering and Technology
- English Language
- Physics
- Telecommunications

First-Line Supervisors/Managers of Mechanics, Installers and Repairers

- Administration and Management
- Mechanical
- Customer and Personal Service
- Production and Processing
- Personnel and Human Resources
- Mathematics
- Education and Training
- Engineering and Technology
- English Language
- Clerical

Electrical and Electronics Repairers, Commercial and Industrial Equipment

- Computer and Electronics
- Mechanical
- Engineering and Technology
- Mathematics
- English Language
- Public Safety and Security
- Design
- Production and Processing

Electrical and Electronics Repairers, Powerhouse, Substation and Relay

- Mechanical
- Design
- Mathematics
- Public Safety and Security
- Computer and Electronics
- Education and Training
- English Language
- Telecommunications
- Physics
- Engineering and Technology

Industrial Machinery Mechanics

- Mechanical
- Mathematics
- Engineering and Technology
- Design
- English Language
- Production and Processing
- Building and Construction

Maintenance and Repair Workers, General

- Mechanical
- Building and Construction
- Public Safety
- Design
- Engineering and Technology
- English Language
- Mathematics
- Education and Training

Electrical Power-Line Installers and Repairers

- Customer and Personal Service
- Mechanical
- Building and Construction
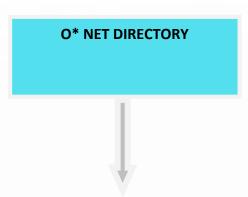- Public Safety and Security
- Education and Training
- Transportation

Power Plant Operators

- Mechanical
- Public Safety and Security
- Computer and Electronics
- English Language
- Chemistry

Tier 7 —Occupation-Specific Technical Competencies

All occupations require certain technical competencies to perform the job. This tier contains **technical competencies** that are specific to the eleven targeted Energy occupations as listed below.

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O* NET DIRECTORY

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TIER 7 –Occupation Specific Technical Competencies for:
Chemical Engineers
Electrical Engineers
Chemists
Electricians
First-Line Supervisors/Managers of Mechanics, Installers and Repairers
Electrical and Electronics Repairers, Commercial and Industrial Equipment
Electrical and Electronics Repairers, Powerhouse, Substation and Relay
Industrial Machinery Mechanics
Maintenance and Repair Workers, General
Electrical Power-Line Installers and Repairers
Power Plant Operators

Occupation Related Competencies

Chemical Engineers

Tools used in this occupation	Technology used in this occupation
Freezedryers or lyophilzers Heat exchangers Laboratory mixers — Benchtop mixers; Mixing tanks; Powder mixing equipment Microcontrollers — Programmable logic controllers PLC Vacuum pumps	Analytical or scientific software — Chempute Software Engineer's Aide SINET; G&P Engineering Software EngVert; SoftLab PHEdesign; Thermal Analysis Systems The Energy Analyst Computer aided design CAD software — CD-adapco STAR-CAD; SolidWorks CAD software Data base user interface and query software — Chempute Software E-Notebook; G&P Engineering Software PhysProps; Microsoft Access; Relational database software Object or component oriented development software — C++; Microsoft Visual C# .NET Spreadsheet software — Microsoft Excel

Electrical Engineers

Tools used in this occupation	Technology used in this occupation
Laboratory evaporators — Electron beam evaporators; Filament evaporators; Metal evaporation systems; Vacuum system/thermal evaporators Semiconductor process systems — Spin-coaters; Wafer steppers; Wet chemical clean benches; Wire bonders Signal generators — Programmable function generators; Synthesized continuous wave CW generators; Vector signal generators Spectrometers — Auger electron spectrometers; Electrochemical CV dopant profilers; Photoluminescence spectrometers; X ray photoemission spectrometers Tube furnaces — Doping tubes; Oxidation tubes; Vertical furnaces	Analytical or scientific software — Finite element method FEM software; Synopsys PrimeTime; Tektronix EZ-TEST; The Mathworks MATLAB Computer aided design CAD software — Autodesk AutoCAD software; Cadence Encounter Test; Mento Graphics software; OrCAD Capture Development environment software — C; Microsoft Visual Basic; Programmed logic controller PLC code generation software; VHSIC hardware description language VHDL Object or component oriented development software — C++; JHDL; Practical extraction and reporting language Perl; Python Program testing software — Debugging software; Defect tracking software

Chemist

Tools used in this occupation	Technology used in this occupation
Benchtop centrifuges — Chemical centrifuges; High-speed centrifuges; Tabletop centrifuges Hematology or chemistry mixers — Automatic peptide synthesizers; Mini synthesizers	Analytical or scientific software — Agilent ChemStation; Laboratory information management system LIMS software; Waters Empower Chromatography Data Software; Wavefunction Spartan

Lasers — Diode lasers; Dye lasers; Nitrogen lasers; Picosecond lasers	Computer aided design CAD software — ChemInnovation Software Chem 4-D; ChemSW Molecular Modeling Pro; Hypercube HyperChem
Spectrometers — Luminescence spectrometers; Ultraviolet-visible spectrometers	Data base user interface and query software — ChemSW Buffer Maker; Microsoft Access; Molsearch Pro; Structured query language SQL
X ray diffraction equipment — Single crystal x ray diffractometers	Graphics or photo imaging software — Digital imaging software; Graphics software; MolDraw *
	Inventory management software — ChemSW Chemical Inventory System CIS; ItemTracker software; UBI Biotracker

Electricians

Tools used in this occupation	Technology used in this occupation
Cable reels — Single reel cable trailers; Wheeled wire dispensers; Wire dollies; Wire hand caddies	Analytical or scientific software — Electrosoft FlashWorks; Elite ECOORD; Lighting calculation software; SoftEmpire Electrical Calculations
Screwdrivers — Cabinet tip screwdrivers; Insulated screwdrivers; Round shank screwdrivers; Square shank screwdrivers	Computer aided design CAD software — One Mile Up Panel Planner; SmartDraw software
Stripping tools — Automatic insulation strippers; Self-adjusting insulation strippers; Universal stripping tools; Wire strippers	Data base user interface and query software — Insight Direct ServiceCEO; Resolve service management software; Sage Timberline Office software; Shafer Service Systems software
Voltage or current meters — Milliameters; Test lamps; Volt tick meters; Voltmeters	Project management software — Construction Master Pro software; Craftsman CD Estimator
Wire or cable cutters — Cable butt trimmers; High-leverage cable cutters; Insulated cable cutters; Utility cable cutters	Word processing software — Socrates Contractor's Library

First-Line Supervisors/Managers of Mechanics, Installers and Repairers

Tools used in this occupation	Technology used in this occupation
Desktop computers	Data base user interface and query software — Database software; Microsoft Access; Vehicle management software
Laser printers	
Mainframe computers	Facilities management software — Computerized maintenance management system CMMS software; Maintenance management software
Microcontrollers — Programmable logic controllers PLC	
Two way radios	Inventory management software — Automated inventory software
	Spreadsheet software — Microsoft Excel
	Word processing software — Microsoft Word

Electrical and Electronics Repairers, Commercial and Industrial Equipment

Tools used in this occupation	Technology used in this occupation
Microcontrollers — Programmable logic controllers PLC; Proportional integral derivative PID controllers; Teach pendants	Computer aided design CAD software — Autodesk AutoCAD software
Pipe bending tools — Hydraulic pipe benders; Pipe benders; Polyvinyl chloride PVC benders	Enterprise resource planning ERP software — SAP Maintenance
Punches or nail sets or drifts — Knockout punches; Punches; Screw starters	Facilities management software — Computerized maintenance management system CMMS software; Maintenance management software
Voltage or current meters — High-voltage detectors; Low voltage detectors; Test lamps; Voltmeters	Office suite software — Microsoft Office software
Winches — Cable winches; Wire winches	Word processing software — Microsoft Word

Electrical and Electronics Repairers, Powerhouse, Substation and Relay

Tools used in this occupation	Technology used in this occupation
same as **Electrical and Electronics Repairers, Commercial and Industrial Equipment**	same as **Electrical and Electronics Repairers, Commercial and Industrial Equipment**

Industrial Machinery Mechanics

Tools used in this occupation	Technology used in this occupation
Hoists — Chain falls; Chain hoists	Computer aided design CAD software
Lathes — Engine lathes; Turning lathes	Computer aided manufacturing CAM software — Extranet Machine Tools Suite
Power grinders — Cylindrical grinders; Grinding wheels; Precision grinders	Data base user interface and query software — Maintenance planning and control software
Welders — Arc welders; Electric welding equipment; Spot welders	Industrial control software — BIT Corp ProMACS PLC; KEYENCE PLC Ladder Logic
Workshop presses — Drill presses; Hydraulic squeezers; Punch presses	Word processing software — Microsoft Word

Maintenance and Repair Workers, General

Tools used in this occupation	Technology used in this occupation
Drain or pipe cleaning equipment — Drain augers; Drain cleaning cables; Hand spinners; Power drain cleaners	Calendar and scheduling software — Computerized time management systems
Pipe or tube cutters — Copper cutting machines; Ratcheting polyvinyl chloride PVC cutters; Soil pipe cutters; Tubing cutters	Facilities management software — Computerized maintenance management system CMMS software
Power drills — Cordless power drills; Direct tap machines; Hand drills; Right-angle drills	Industrial control software — Digital Direct Control DDC Energy Management software
Power saws — Circular saws; Radial arm saws;	Spreadsheet software — Microsoft Excel

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Reciprocating saws; Tile saws	Word processing software — Microsoft Word
Pullers — Bearing pullers; Chain pullers; Comealongs; Tub drain removers	

Electrical Power-Line Installers and Repairers

Tools used in this occupation	Technology used in this occupation
Conduit benders — Cable benders; Hand benders; Hydraulic benders; Power benders	Electronic mail software — Email software
Power drills — Electric drills; Gas drills; Hammer drills; Hydraulic drills	Inventory management software
Saws — Buck saws; Hacksaws; Hand saws; Keyhole saws	Office suite software — Microsoft Office software
Voltage or current meters — Current leakage meters; Digital recording amp meters; Digital voltmeters DVM; Insulator testers	
Wire or cable cutters — Cable cutters; Hydraulic cutters; Insulated cable cutters; Ratchet cutters	

Power Plant Operators

Tools used in this occupation	Technology used in this occupation
Heat exchangers — Fin fan heat exchangers; Plate exchangers; Shell and tube heat exchangers	Data base user interface and query software — Microsoft Access
Low voltage alternating and direct current AC DC panelboards — Control boards; Panel boards; Transformer controls	Facilities management software — Computerized maintenance management system CMMS software
Steam engines — Steam distribution systems; Steam turbines	Industrial control software — Distributed control systems DCS software; General Electric Mark VI Distributed Control System DCS; Teknik Segala OSI Plant Information PI System; Yokogawa FAST/TOOLS
Steam generators — Heat recovery steam generators; Steam driven turbogenerators	Presentation software — Microsoft PowerPoint
Wet scrubbers — Selective catalytic reactors; Selective non-catalytic reactors; Wet scrubber systems	Spreadsheet software — Microsoft Excel

Occupation Related Competencies

Tier 8 – Occupation Specific Requirements

This tier includes **occupation specific job credentials** such as educational degrees, certifications, licensures and physical training requirements specific to a particular occupation within an industry. The US Department of Education provides a taxonomic scheme of programs of study and descriptions called Classification of Instructional Programs (CIP). The National Crosswalk Service Center linked this data with the list of occupations in the O*NET Directory and created a comprehensive list of instructional programs for each occupation in each industry.

O* NET DIRECTORY

TIER 8 –Occupation Specific Requirements for:
Chemical Engineers
Electrical Engineers
Chemists
Electricians
First-Line Supervisors/Managers of Mechanics, Installers and Repairers
Electrical and Electronics Repairers, Commercial and Industrial Equipment
Electrical and Electronics Repairers, Powerhouse, Substation and Relay
Industrial Machinery Mechanics
Maintenance and Repair Workers, General
Electrical Power-Line Installers and Repairers
Power Plant Operators

Chemical Engineers

CIP Code	CIP Title
14.0701	Chemical Engineering

Electrical Engineers

CIP Code	CIP Title
14.1001	Electrical, Electronics and Communications Engineering

Chemists

CIP Code	CIP Title
40.0501	Chemistry, General
40.0502	Analytical Chemistry
40.0503	Inorganic Chemistry
40.0504	Organic Chemistry
40.0506	Physical and Theoretical Chemistry
40.0507	Polymer Chemistry
40.0508	Chemical Physics
40.0599	Chemistry, Other

Electrician

CIP Code	CIP Title
46.0302	Electrician

First-Line Supervisors/Managers of Mechanics, Installers, and Repairers

CIP Code	CIP Title
52.0205	Operations Management and Supervision

Electrical and Electronics Repairers, Commercial and Industrial Equipment

CIP Code	CIP Title
47.0104	Computer Installation and Repair Technology/Technician
47.0105	Industrial Electronics Technology/Technician

Electrical and Electronics Repairers, Powerhouse, Substation and Relay

CIP Code	CIP Title
47.9999	Mechanic and Repair Technologies/Technicians, Other

Industrial Machinery Mechanics

CIP Code	CIP Title
47.0303	Industrial Mechanics and Maintenance Technology
47.0399	Heavy/Industrial Equipment Maintenance Technologies, Other

Maintenance and Repair Workers, General

CIP Code	CIP Title
46.0412	Building/Construction Site Management/Manager

Electrical Power-Line Installers and Repairers

CIP Code	CIP Title
46.0301	Electrical & Power Transmission Installation/Installer, General
46.0303	Lineworker
46.0399	Electrical and Power Transmission Installers, Other

Power Plant Operators

CIP Code	CIP Title
47.9999	Mechanic and Repair Technologies/Technicians, Other

Tier 9 – Management Competencies

This tier includes competencies that are specific to supervisory and managerial occupations within this industry. These competencies are:

- Manpower Planning
- Delegating
- Managing Work Flow
- Entrepreneurship
- Leadership
- Developing & Monitoring
- Preparing and Managing Budgets
- Team Building
- Developing an Organizational Vision
- Managing Resources

Competency models can serve as a map for education/training providers, employers, job seekers, workforce and economic developers. Working together in cooperation these agencies can help create an "Energy ready" workforce for Missouri. Some recommendations for the use of the Energy competency Model are:

1. As emphasized continuously by employers, one of the key findings of this study was the need for an "interdisciplinary" knowledge base. This message needs to be conveyed to all education providers in the state. The Department of Economic Development (DED) can collaborate with partners in the Missouri Department of Higher Education (MDHE) to promote educational efforts geared towards preparing students for college and the workplace. This work could be accomplished through :
   ❖ Creating a cross-walk between the Curriculum Alignment Initiative entry-level competencies and the foundational competencies in Tiers 1 & 2
      ❖ Having MDHE promote the findings of the Energy Competency Model report to postsecondary institutions, for their use in reviewing current curriculum for Energy-related degree programs and aligning business driven competencies with entry and exit skills as defined by education/training providers
   ❖ Present progress on these activities to the P-20 Council by the end of state fiscal year 2010
2. As the Energy field contains both occupations that require postsecondary training as well as those that do not, hence training/development needs to start as early as K-12. The Department of Elementary Secondary Education (DESE) along with the Missouri Center for Career Education can use several of the report's findings as a useful tool in their role as a change agent for the field of career education in Missouri in the following ways:
   ❖ Utilize Tiers 1-5 as the basis for developing measurable learner objectives (MLOs) for use by classroom teachers in an occupational area
   ❖ For programs that are occupationally specific and represented in the targeted sectors, Tier 5 could also be used as a basis for curriculum development
   ❖ The model could also be used as a resource for new teacher induction programs and other professional development efforts
   ❖ The results could be integrated into work on programs of study, curriculum development and data driven decision making
3. The competencies derived from the Energy competency model serve as a training map for specific Energy occupations and could be compared to current training available in public postsecondary institutions to identify "skill gaps" as identified by employers with results tied to regional demand. A further gap analysis between Missouri employer training needs versus Missouri education/training program offerings could be conducted.
4. Integrate the Energy competency model results in the development of career information products for job seekers and both elementary/secondary and postsecondary students. This could be disseminated through :
   ❖ The Public Outreach Partnership (POP), a collaborative workgroup with representatives from DESE, DHE, MERIC, Department of Economic Development Division of Workforce Development (DWD), MCCE and the Missouri Chamber of Commerce

- The POP workgroup represents state agencies concerned with education and workforce development that are helping inform and build awareness among the public, particularly students and potential students, of targeted careers, educational and industry trends and workforce development priorities
- ❖ Missouri Connections, a website that helps students (grades 7-16), their parents, guidance counselors and educators in career exploration and education planning

1. Mark McMurtery, James P. Downey, Steven M. Zeltmann and Wolliam H. Friedman, *Critical Skill Sets of Entry-Level IT Professionals: An Empirical Examination of Perceptions from Field Personnel*, Journal of Information Technology Education, Volume 7 2000.

2. MERIC, Occupational Projections –Statewide(2008-2018).

3. MERIC & U.S. Census Bureau.

4. Richard Mansfield, *Practical Questions for Building Competency Models*, 2000.

5. National Workforce Center for Emerging Technologies, *Building a Foundation for Tomorrow*, *Skills Standard for Information Technology*, 2003 edition.

6. Key Links Inc., *A Guide for the Overall Usefulness of Industry Competency Models*.

7. Washington State Board for Community and Technical Colleges and Shoreline Community College, *Skills Standards for Biotechnology*.

8. Center for Energy Workforce Development, CEWD - http://www.cewd.org/.

9. Utah State Office of Education, Career and Technical Education.

10. Mid Continent Research For Education and Learning (MCREL)- http://www.mcrel.org.

11. *O*Net* - http://online.onetcenter.org/.

12. Competency Clearing House - http://www.careeronestop.org/competencymodel/.

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